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No.	Publication number	Publication date	Inventor	Title	EN -> Anzeige PDF	EN Fam Rech
1	DE0004129893A1	11.03.1993	Maus, Wolfgang, 5060 Bergisch Gladbach, DE Brück, Rolf, 5060 Bergisch Gladbach, DE	Anordnung zur Temperaturmessung und/oder Heizung und deren Verwendung ...		Se

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Empfangsbescheinigung

DEUTSCHES PATENTAMT

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Anmeldercode-Nr.	Vertretercode-Nr.	Zustelladreßcode-Nr.
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⑥ **Bezeichnung der Erfindung** *(bei Überlänge auf gesondertem Blatt - 2fach)*

Anordnung zur Temperaturmessung und/oder Heizung und deren Verwendung in einem Wabenkörper, insbesondere Katalysator-Trägerkörper

⑦ s. Erläuterungen u. Kostenhinweise auf der Rückseite

Sonstige Anträge

Aktenzeichen der Hauptanmeldung (des Hauptpatents)

☐ Die Anmeldung ist **Zusatz** zur Patentanmeldung (zum Patent) →
☐ **Prüfungsantrag** - Prüfung der Anmeldung (§ 44 Patentgesetz)
☒ **Recherchenantrag** - Ermittlung der öffentlichen Druckschriften ohne Prüfung (§ 43 Patentgesetz)
Lieferung von Ablichtungen der ermittelten Druckschriften im ☐ Prüfungsverfahren ☒ Recherchenverfahren
☐ **Aussetzung** des Erteilungsbeschlusses auf ________ Monate (§ 49 Abs. 2 Patentgesetz) *(Max. 15 Mon. ab Anmelde- oder Prioritätstag)*

⑧ **Erklärungen**

Aktenzeichen der Stammanmeldung

☐ **Teilung/Ausscheidung** aus der Patentanmeldung →
☐ an **Lizenzvergabe** interessiert (unverbindlich)
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⑨ ☐ Inländische **Priorität** (Datum, Aktenzeichen der Voranmeldung)
☐ Ausländische **Priorität** (Datum, Land, Aktenz. der Voranmeldung)
bei Überlänge auf gesondertem Blatt - 2fach)

⑩ Erläutergn. und Kostenhinweise s. Rückseite

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DEUTSCHES PATENTAMT (Dienstsiegel) 73

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ARRANGEMENT FOR TEMPERATURE MEASUREMENT AND/OR HEATING, AND ITS USE IN A HONEYCOMB BODY, IN PARTICULAR A CATALYST CARRIER BODY

The present invention relates to an arrangement that is especially well suited for use for temperature measurement and/or heating in a metal honeycomb body, in particular a catalyst carrier body, for exhaust systems of internal combustion engines.

As emissions regulations for internal combustion engines, particularly in motor vehicles, become ever more stringent all over the world, catalytic converters are increasingly being us d to detoxify the exhaust gases. It is generally necessary to regulate the combustion process of an engine as a function of many measured values, and also to monitor the functional capability and status of a downstream catalytic converter and include it in the regulation as needed. In particular, this requires temperature measurements in the exhaust system and/or in the catalytic converter itself.

The basic design of a catalytic converter is described for instance in International Application WO 89/07488; this describes particularly a metal honeycomb body that comprises many sheet-metal layers, at least some of them structured and one or more of which are reinforced; these sheet-metal layers comprise two or

more identically structured sheet-metal layers resting in contact with one another.

Various versions of honeycomb bodies made up of structured sheet-metal layers, in particular alternatingly arranged smooth and corrugated sheet-metal layers, are often known from International Application WO 90/03220. International Application WO 89/10471 also discloses an electrical heating arrangement for such honeycomb bodies.

Finally, the earlier application PCT/EP89/00311, the publication date of which does not precede the filing date of the present application, shows various options for integrating temperature sensors into a metal honeycomb body in order to measure the temperature in it directly.

One problem in measuring temperature in the exhaust gas and especially in the interior of a catalytic converter is that th exhaust gas, at temperatures that may be above 1000°C under som circumstances, act highly corrosively, so that alloys that in principle would be well suited for temperature sensors or as h at conductors cannot readily be used unprotected.

Another problem is that the exhaust gas flow in an exhaust system does not have a uniformly distributed profile over th cross-section of the exhaust system, so that spot measurement of temperature is generally not especially conclusive. For this reason, and as already indicated in PCT/EP89/00311, the

measurement should, if possible, be performed linearly over a representative cross-section of the exhaust system.

The object of the present invention is to create an arrangement for temperature measurement or heating that in particular can be used in the interior of catalytic converters, and that permits the use of arbitrary materials without consideration of their corrosion properties.

To attain this object, an arrangement for temperature measurement and/or electric heating is used that includes

a) at least two layers, namely an upper layer and a lower layer, which predominantly rest tightly against one another and comprise identically structured metal foils;

b) at least one void between the two layers, formed by bulging out of at least one of the two layers;

c) at least one temperature sensor and/or heat conductor, which extends in the void or whose supply lines extend in the void.

In such an arrangement, the upper and lower layers may comprise a high-temperature and corrosion-proof material and can protect the actual temperature sensor or its supply lines. The present invention is equally suitable for both punctiform measuring sensors, whose supply lines need to be protected, and for sensors or heat conductors that measure linearly or over a large surface area, all of which must be protected. Typically, temperature sensors comprise a resistor wire or resistor foil,

particularly of nickel alloys. So-called jacket measuring conductors are often used, in which a resistor wire, imbedded in a layer of electrically insulating ceramic powder, is disposed in a small metal-jacketed tube. The invention is especially suited to such jacket measuring conductors, but precisely because of the presence of the protecting upper and lower layers it is also possible to embed a measuring conductor directly between electrically insulating layers. A measuring conductor may be connected by its end to the upper or lower layer, so that only one electrically conducting lead has to be laid and connected, while the other connection is made by the typically present contact of the upper and lower layers to ground. In principle, however, the invention is also suitable for two-lead or even multiple-lead arrangements, in particular for conductors laid in the shape of a U in a small jacket tube.

Since very thin metal foils with a thickness of 0.02 to 0.1 mm are generally used for the upper and lower layers, it is useful to form the void in which heat conductors, temperature sensors and supply lines, hereinafter all called measuring conductors, are to be laid, by bulging out of both layers, so that the necessary deformations are not overly extensive. In principle, however, it is also possible to create a void in only one of the two surrounding layers by bulging outward. The arrangement according to the invention can be accommodated practically in any arbitrarily structured sheet-metal layers, but

it is proved especially suitable if the sheet-metal layers have a corrugation in which the waves have a predetermined wave height and the measuring conductor extends approximately crosswise to the corrugation. For the later buildup of a honeycomb body, it is especially favorable if the outward bulges are embodied such that they do not change the wave height but instead always contact the insides of the wave. This kind of arrangement can, for instance, be produced by providing that a measuring conductor is rolled in between two metal foils by means of two intermeshing toothed rollers, in particular with involute toothing. In this process the two rollers for producing corrugated products are provided on the outside in the circumferential direction with a groove, whose depth is approximately equal to the diameter of th measuring conductor to be rolled. This groove means a notching-in of only those teeth of the corrugated rollers that later form the insides of the corrugation. In this way, a measuring conductor can be rolled precisely in such a way that it always extends on the inside of the corrugation and thus does not aff ct the wave height, so that the wave combs on both sides of the corrugation do not allow the presence of the measuring conductor to be apparent. This can play a decisive role in later processing to make a metal honeycomb body.

Although in principle it is possible to roll a measuring conductor between smooth foils as well, for example using a pair of rollers in which at least one roller comprises an elastic

material, nevertheless this kind of smooth sheet-metal layer cannot be arbitrarily well processed further to make a honeycomb body, since the outward bulge may under some circumstances require a corresponding groove in adjacent structured sheet-metal layers as well as a smooth sheet-metal layer with an outward bulge that is more flexionally stiff than typically smooth she t-metal layers. In contrast to that, a corrugated sheet-metal layer with a measuring conductor is very elastic, cannot be distinguished from a typical corrugated sheet-metal layer by its external lines of contact, and because of the corrugation, it can receive a substantially longer temperature sensor or heat conductor than a smooth sheet-metal layer, which can markedly increase the measurement accuracy or allows arbitrary resistances on the part of the heat conductor.

For long-term stability in a corrosive medium, it may be important for the measuring conductor to be accommodated in fact in a gas-tight manner between the two layers. To achieve this it is useful to join the layers together in a gas-tight manner, at least at their edges, and preferably to solder them. In particular, this can be achieved by rolling a thin, for instance self-adhesive soldering foil along the edges of the layers simultaneously with the measuring conductor, so that soldering can be done in a later production step. Naturally the upper and lower layers may also be formed by folding only a single foil, so that then only every other edge needs to be soldered.

Particularly if the layers alone or together with other sheet-metal layers, at least some of which are structured, are formed to make a honeycomb body that has a multiplicity of channels through which a fluid can flow, soldering of the sh et-metal layers takes place at the face end in any case later, so that by means of this process alone, soldering of both the layers that protect the measuring conductors can already be done. Once again, however, if an additional soldering foil is rolled in jointly, the quality and tightness can be improved. As will be described in detail later in conjunction with the drawing, it is especially favorable if the temperature sensor arrangement is formed alone or together with other sheet-metal layers, at least some of which are structured, to form a honeycomb body that serves as a carrier body for catalytically active material. In that case, the temperature sensor measures not the gas temperature in the exhaust gas of an internal combustion engine but rather directly measures the wall temperature in the catalytic converter, which increases the confidence level of th temperature measurement in terms of its functional capability.

Typically, such honeycomb bodies are surrounded by a jacket tube, through which the measuring conductor must naturally be passed. This can be done according to the invention in particular through a window, and this is especially favorable from a production standpoint. The upper and/or lower layer then has an elongated connection strap, which with the measuring

conductor embedded in it can be passed through the window to the outside without impeding any production process especially.

It should be pointed out that the arrangement according to the invention, while being especially well-suited to temperature measurement or heating in a metal honeycomb body, is not limit d to that application. In principle, such arrangements can also be used in other locations.

Exemplary embodiments of the invention, to which the invention is not limited, however, are shown in the drawings; shown are:

Fig. 1, a jacket measuring conductor rolled in between two smooth foils;

Fig. 2, a measuring conductor rolled in between two corrugated foils;

Fig. 3, a measuring conductor foil rolled in between two smooth sheet-metal layers;

Fig. 4, a stack of metal sheets for producing a honeycomb body with a temperature sensor arrangement laid between them;

Fig. 5, a honeycomb body made from the stack shown in Fig. 4;

Figs. 6 and 7, various options for the course of measuring conductors between two metal foils; and

Fig. 8, schematically, the course of outward bulges in temperature sensor arrangements corrugated according to the invention.

Fig. 1, in a perspective view, cut crosswise, shows a smooth upper layer 11 and a smooth lower layer 12, both of which have outward bulges 13. Located in the void formed by the outward bulges 13 is a jacket measuring conductor, comprising a small metal jacket tube 15, an insulating layer 16, and a measuring conductor 17. At the edges, the upper layer 11 and the lower layer 12 are joined together in gas-tight fashion by soldered connections 14, so that they protect the jacket measuring conductor 15, 16, 17 completely against corrosive gases.

Fig. 2 shows a corrugated upper layer 21 and a corrugat d lower layer 22, which again both have outward bulges 23 that form a void. A measuring conductor 27 is embedded in this void and is electrically insulated from the surrounding layers by an insulating layer 26. Once again, the upper layer 21 and the lower layer 22 are joined in gas-tight fashion at their edges by soldered connections 24.

Fig. 3 shows a different variant, namely the integration of a measuring conductor foil 37 between an upper layer 31 and a lower layer 32. Outward bulges 33 with a relatively flat course here form a generally flat void 38, in which the measuring conductor foil 37 is disposed, embedded between two insulating layers 36, for instance of nonwoven material. Once again, th edges are sealed off by soldered connections 34.

All the measuring conductor arrangements shown in the exemplary embodiment can be integrated into either smooth or structured sheet-metal layers; naturally it is also possible to accommodate two or more spaced-apart measuring conductors.

As shown in Figs. 4 and 5, smooth or structured foils with measuring conductors embedded in them can be integrated into a production process without difficulty to produce metal catalyst carrier bodies. One such production process, which is also applicable to sheet-metal layers of differing thicknesses, has already been described in detail in International Application WO 89/07488 and the references cited in it, so that reference need be made here only to the particular features resulting from the presence of the temperature sensor. Fig. 4 shows a stack of alternatingly arranged layers of smooth sheets 1 and corrugated sheets 2, inside which are located an upper layer 41 and a lower layer 42 with a jacket measuring conductor 45, 46, 47 located between them. This layer has an elongated connection strap 48, which protrudes laterally out of the stack 40. The jacket measuring conductor 45, 46, 47 is also located in this connection strap 48, between outward bulges 43; for the sake of later connection or to accommodate a connection socket, the jacket measuring conductor in turn protrudes out of the connection strap 48. As known from the prior art, the entire stack 40 may be wound in opposite directions around two fixed points 3, 4 and accommodated in a jacket tube 50. By rotating the stack of

sheets 40 in the jacket tube 50, the connection strap 48, as shown in Fig. 5, can be put into a position in which it protrudes out of a window 59 present in the jacket tube 50. The jack t measuring conductor 45, 46, 47 is then protected up to where it emerges from the window 59 and for some distance beyond that by the surrounding connection strap 48, so that a leak-proof lead-through to the outside is reliably possible. The connection strap 48 may for instance be accommodated in a small soldered-on or welded-on connection tube with an adjoining connection sock t; this provides a very sturdy connection capability. For this arrangement it does not matter whether the measuring sensor arrangement comprises smooth or corrugated sheet-metal layers, because this does not affect the production process. Nor does the honeycomb body differ otherwise from the known bodies in terms of its properties and its channels 5 through which a fluid can flow. Particularly when the honeycomb body is soldered at the face end, the upper layer 41 and the lower layer 42 with a connection 44 are tightly protected against the entry of corrosive exhaust gas. This exhaust gas cannot reach the jacket measuring conductor at any point. Naturally it is not necessary to use a jacket measuring conductor comprising a small metal jacket tube 45, insulating layer 46 and measuring conductor 47 for the described arrangement. The variants shown in Figs. 2 and 3 can equally be used.

Fig. 6 schematically shows that a measuring conductor or its supply line 67 need not absolutely extend in a straight lin between an upper layer 61 and a lower layer 62. In principle, practically any desired course can be made possible by the rolling in process. Even if measurement is to be done only at a single point in punctiform fashion, the arrangement according to the invention is suitable for that purpose. For instance, a thermocouple that generates a thermoelectric voltage can be disposed punctiform and connected via measuring conductors 67. It is then in principle also possible to join the upper and lower layers at a contact point 68 to a measuring conductor made of some suitable other metal, in this way creating a thermoelectric voltage. An arrangement is equivalent in structure where a resistor wire is connected at a contact point 68 to the upper layer 61 or the lower layer 62 acting as a ground.

In Fig. 7, a measuring conductor 77 may naturally also b laid in a U shape between an upper layer 71 and a lower layer 2, so that its two ends can be extended to the outside at differ nt points. This variant and many other variants can be achieved with the temperature sensor arrangement of the invention. In particular, the variants described in PCT/EP89/00311, which is hereby entirely incorporated by reference, can be achieved, although with the limitation that not the gas temperature in a honeycomb body but rather preferably the wall temperature can be measured.

Fig. 8, finally, again schematically in longitudinal section, shows the course of the outward bulges 83 for corrugated sheet-metal layers 81 and 82 resting on one another, and between which a measuring conductor, not shown, is disposed. As suggested by dashed lines, the outward bulges are always located on the inside of the corrugation, so that the wave height h is unaffected by the outward bulges. The outward bulges 83 intersect the flanks of the corrugation, so to speak, shifting to the inside each time.

The present invention is especially suitable for integrat d temperature-monitoring of a catalytic converter, and in combination with other measuring systems it can especially well be used for emission-reducing engine control and to monitor the functional capability of the catalytic converter. Moreover, an arrangement according to the invention can also be used for electric heating, for example of honeycomb bodies, especially when the heating is to be done with higher voltages and lower current intensities of 5 to 20 A, for instance.

CLAIMS:

1. An arrangement for temperature measurement and/or heating, including

a) at least two layers, namely an upper layer (11; 21; 31; 41; 61; 71) and a lower layer (12; 22; 32; 42; 62; 72; 82), which predominantly rest tight against one another and comprise identically structured metal foils;

b) at least one void (38), formed between the two layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82) by an outward bulge (13; 23; 33; 43; 83) of at least one of the two layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82);

c) at least one temperature sensor (15, 16, 17; 27; 37; 45, 46, 47; 67; 77) and/or heat conductor, which extends in the void (38) or whose supply lines (67) extend in the void (38).

2. The arrangement of claim 1, characterized in that the void (38) is formed by outward bulges (13; 23; 33; 43; 83) in both layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82).

3. The arrangement of claim 1 or 2, characterized in that the layers (21, 22; 81, 82) have a corrugation of a predetermined

wave height (h), and the temperature sensor (27) or heat conductor extends approximately transversely to the corrugation.

4. The arrangement of claim 3, characterized in that the outward bulges (83) are designed such that they do not change the wave height (h) but rather always are located on the insides of the wave.

5. The arrangement of one of the foregoing claims, characterized in that the arrangement is produced by rolling in of a temperature sensor (17; 27; 37; 47; 67; 77) or heat conductor between two metal foils.

6. The arrangement of one of the foregoing claims, characterized in that the temperature or heat conductor is a generally flat (37) or linear (17; 27; 47; 67; 77) conductor, in particular a resistor wire or a resistor foil.

7. The arrangement of claim 6, characterized in that the sensor (67) or heat conductor is electrically conductively connected on the end at a contact point (68) to the upper and/or lower layer (61, 62).

8. The arrangement of claim 6, characterized in that the sensor (15, 16, 17; 45. 46. 47) is a jacket measuring conductor.

9. The arrangement of one of claims 1 to 5, characterized in that the sensor is a punctiform measuring sensor (68), such as a thermocouple, whose supply lines (67) extend between the layers (61, 62).

10. The arrangement of one of the foregoing claims, characterized in that the two layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82) are joined together in gas-tight fashion at least on their edges, preferably being soldered (14; 24; 34; 44).

11. The arrangement of one of the foregoing claims, characterized in that the sensor (27; 37; 77) or heat conductor, or its supply lines (37), is or are electrically insulated from the upper layer (21; 31; 61; 71) and the lower layer (22; 32; 62; 72) by insulating layers (26; 36).

12. The arrangement of one of the foregoing claims, characterized in that the layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82) comprise high-temperature corrosion-proof steel, in particular an alloy of iron, chromium and aluminum.

13. The arrangement of one of the foregoing claims, characterized in that the layers (11, 12; 21, 22; 31, 32; 41, 42; 61, 62; 71, 72; 81, 82) alone or together with other sheet-metal

layers (1, 2), at least some of which are structured, form a honeycomb body that has a multiplicity of channels (5) through which a fluid can flow.

14. The arrangement of claims 13, characterized in that the honeycomb body is surrounded by a jacket tube (50) which has at least one window (59), through which the temperature sensor (17; 27; 37; 47; 67; 77) or heat conductor or its supply lin s is or are extended to the outside.

15. The arrangement of claim 14, characterized in that the upper layer (41) and/or the lower layer (42) has an elongated connection strap (48), which together with the temperature sensor (47) or heat conductor or its supply lines embedded therein is extended to the outside through the window (59).

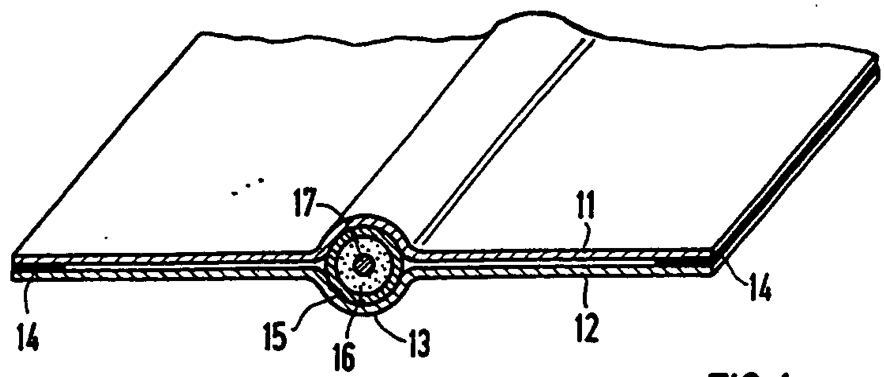

FIG 1

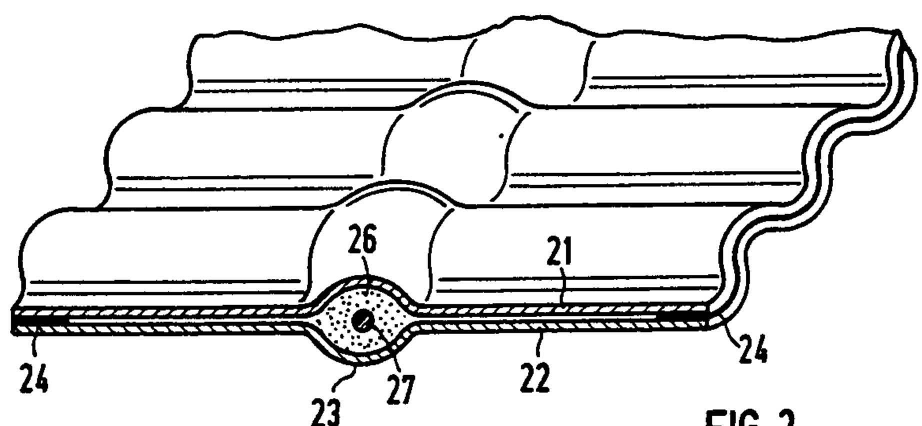

FIG 2

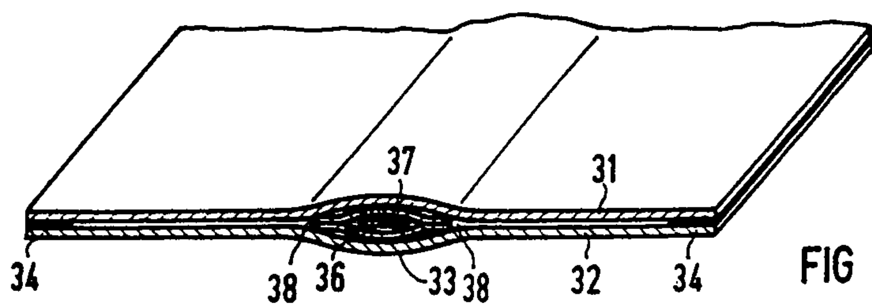

FIG 3

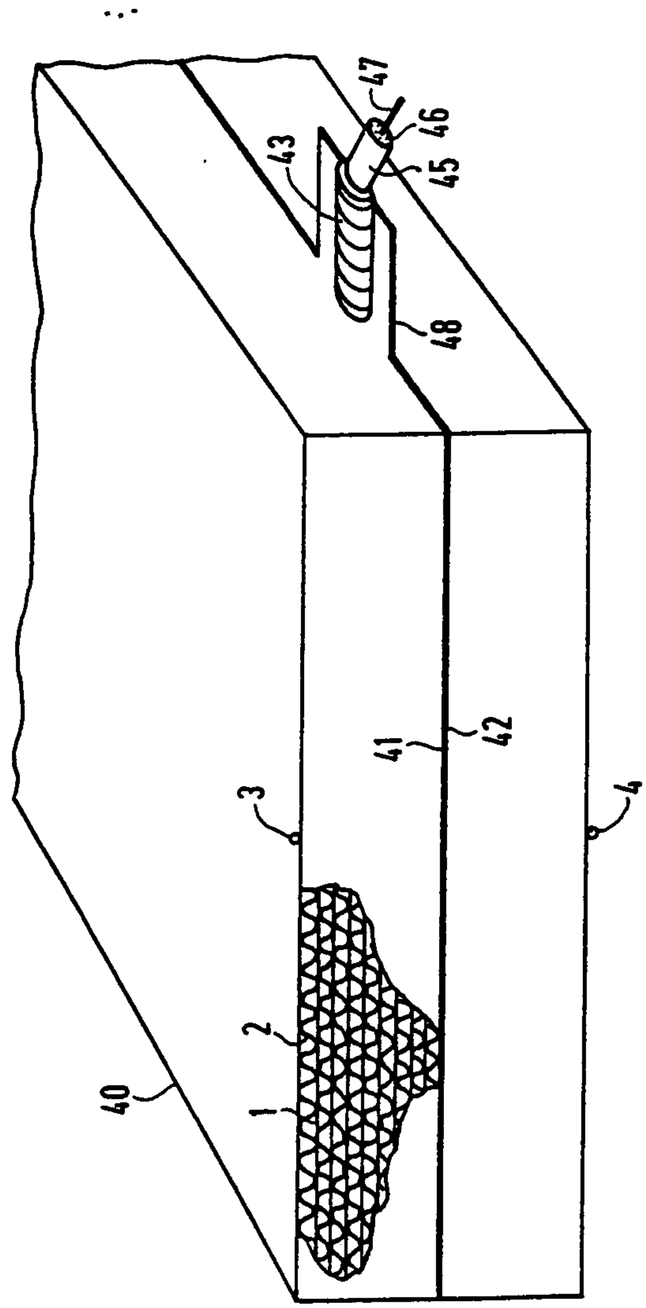

FIG 4

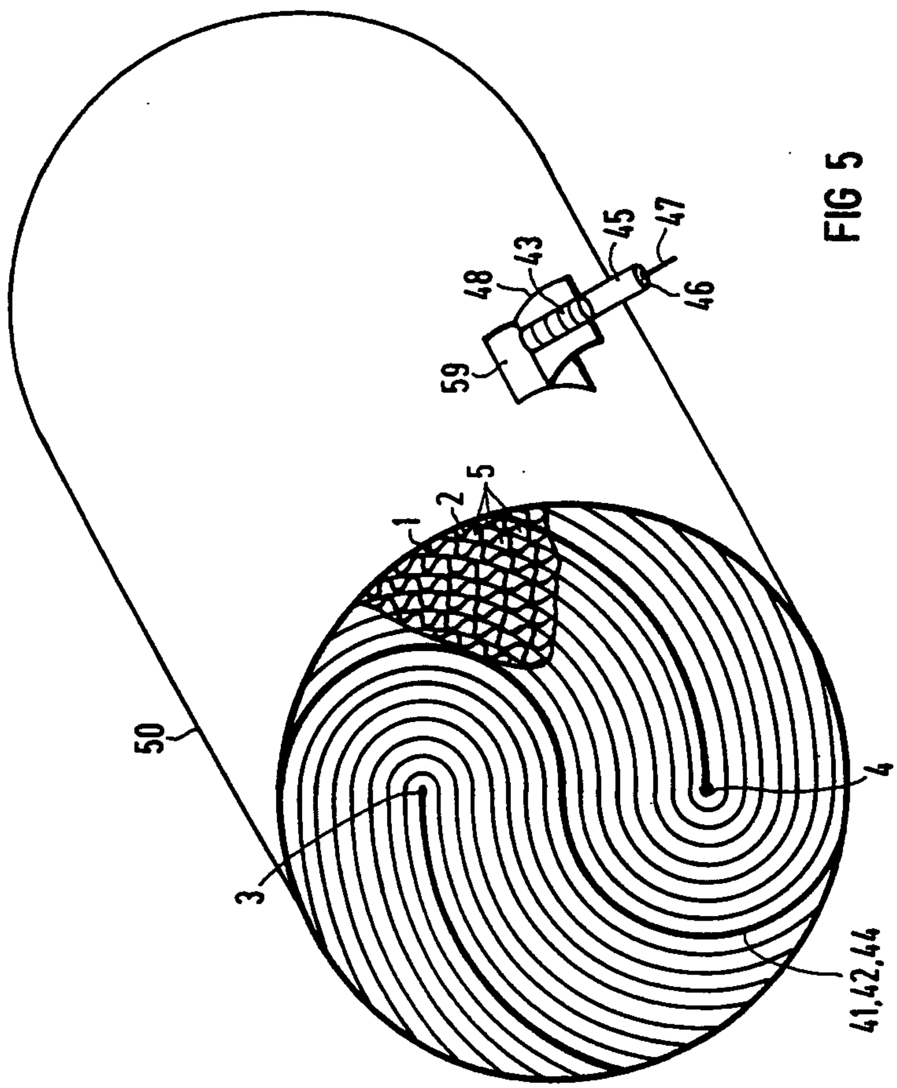

FIG 5

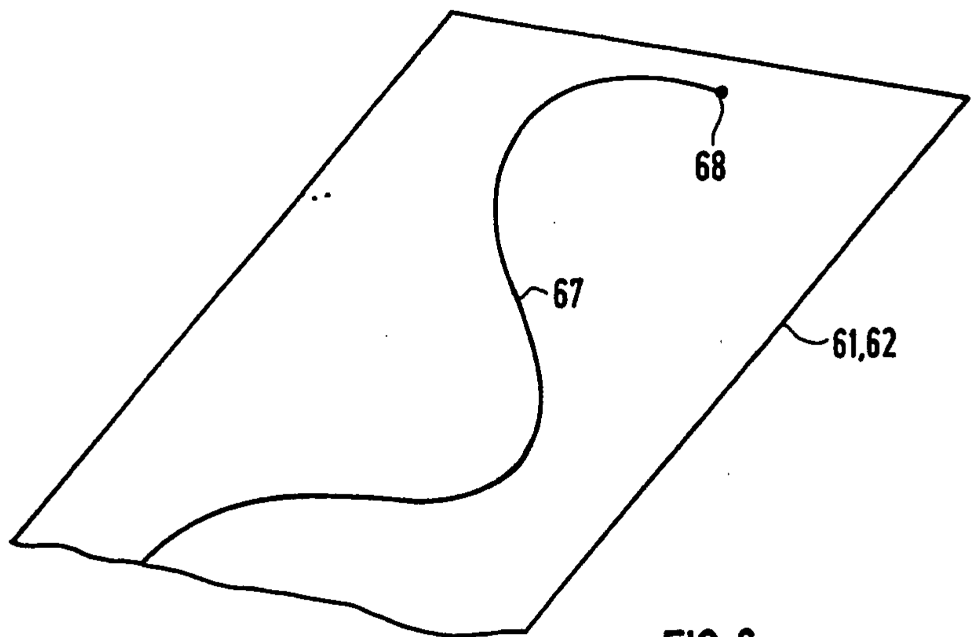

FIG 6

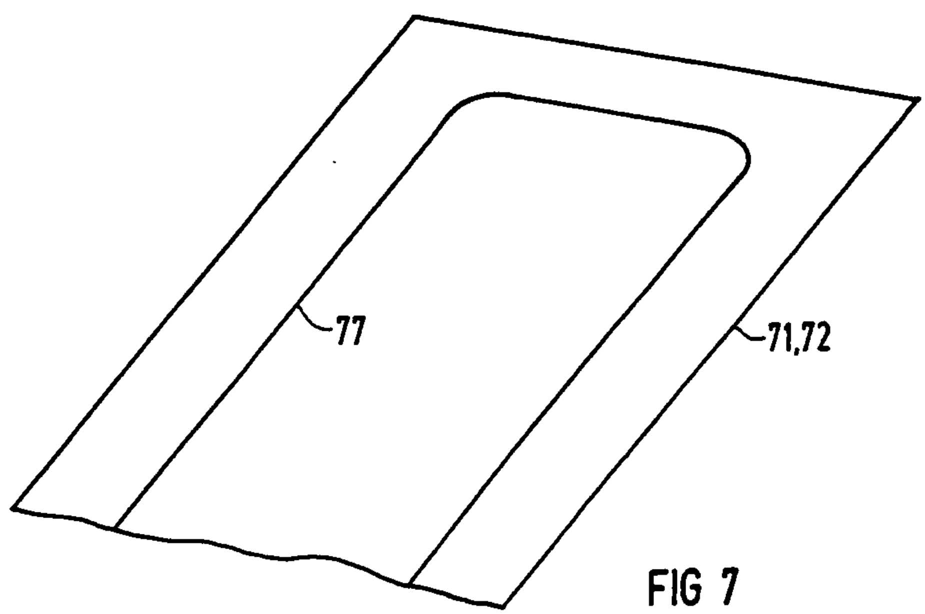

FIG 7

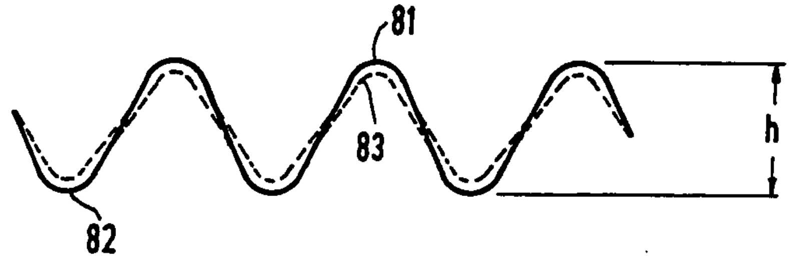

FIG 8

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